

NEST AND COLONY STRUCTURE IN THE PRIMITIVE ANT, *HARPEGNATHOS VENATOR* (SMITH) (HYMENOPTERA: FORMICIDAE)

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Abstract.—Colonies of the primitive ant *Harpegnathos venator* were found to make a simple nest of uniform design with only two nest chambers. Nests were found in clay embankments. Such simple nests are unusual in mature colonies of ants. Interesting characteristic funnels were found constructed both between the chambers and at the nest entrance. Colonies comprised a mean of only 35 workers and a maximum of 72 workers (from 26 colonies excavated). Dealate queens were present in nests. Twenty-one nests contained one queen and 5 nests contained 2 queens. This contrasts with some other primitive ant species where the queen caste has been secondarily lost. Queens, though morphologically distinct, were little larger than workers. Queen weight averaged only 1.4 times the mean worker weight.

Key Words.—Insecta, Hymenoptera, Formicidae, ant, primitive ant, *Harpegnathos*, nest

Harpegnathos is amongst the most bizarre and little-known genera of ants. Recent investigations of the southern Indian species, *Harpegnathos saltator* Jerdon, were prompted by the 1990 International Social Insect conference (IUSI) held in India, where this ant was made the symbol of the conference because of its extraordinary appearance. *Harpegnathos* is frequently compared (Shivashankar et al. 1989, Nascimento et al. 1993) with the primitive *Myrmecia* ants from Australia which also have large size, elongated mandibles, large eyes and primitive traits, such as workers foraging individually. *Harpegnathos*, however, belongs to a different subfamily (subfamily Ponerinae, tribe Ponerini). Its very elongated mandibles are upturned at the end in a most bizarre fashion and it readily makes jumps of more than 10 cm to catch insect prey (Musthak Ali et al. 1992).

In this paper, I investigate a second species of *Harpegnathos*. Nothing is published about *H. venator*, except its taxonomy (Wu 1941). In Hong Kong, where it has been previously recorded (Wu 1941), it is known as “The Jumping Ant” and described as “uncommon” (Hill et al. 1982).

Ponerine ants are particularly interesting because of the secondary loss of the queen caste in a number of species. In this situation, reproductive workers take over the function of the queen caste (Peeters 1991). Nothing has been published about colony size, nest structure, or presence or absence of a queen caste in any species of *Harpegnathos*. I provide this information in this paper for *H. venator* and describe the remarkably simple nest structure of this species.

MATERIALS AND METHODS

Twenty-six colonies of *Harpegnathos venator* were excavated in 1992 and 1993 from Tai Po Kau Nature Reserve and Sha Lo Tung in the New Territories in Hong Kong. Detailed notes and measurements of nest structure were made during nest excavation. All ants present in colonies were collected and brought to the laboratory where queens and workers were counted and measured.

RESULTS

Nest Locations.—All nests were found on steep slopes, typically cut into a hillside beside a constructed footpath. Slopes with *Harpegnathos* nests were all in partially shaded locations in mixed deciduous wooded areas (largely replanted since 1945). All slopes were of exposed clay and sparsely vegetated with occasional moss and small ferns.

Workers.—Nests contained from 8 to 72 workers with a mean of 35.0 workers (interquartile range 25–49). Most workers were found in the upper nest chamber. Workers were remarkably timid. Many remained stationary at (or retreated to) the back wall of their nest chamber, with few workers moving forward out of their nest chamber, even when the nest chamber was broken open. Workers were monomorphic and had a slow “tempo” (i.e., slow, deliberate movements, Hölldobler & Wilson 1990).

Queens.—A queen caste was found in *H. venator*. Of the 26 colonies excavated, 21 colonies contained a single queen and 5 colonies contained 2 queens. Queens were usually found in the upper nest chamber. Queens were morphologically very similar to workers though they could be clearly distinguished by their maximum thorax width (i.e., thorax width at the widest point of the fused meso- and meta-thorax). (Mean maximum thorax width of queens = 2.25 mm, range 2.20–2.35 mm, $n = 10$. For workers, mean = 1.67 mm, range 1.45–1.90 mm, $n = 100$.) Queens were found to possess the full complement of flight-associated sclerites, typical of a generalized hymenopterous thorax (e.g., Wheeler 1910, Bolton 1986, Hölldobler & Wilson 1990). Virgin queens, found newly-eclosed in summer, all possessed full-length wings with hind-wings extending past the abdominal tip (none were brachypterous). Overall, however, queens were little larger than workers. Queens were an average of only 1.4 times average worker weight. (Mean dry weight of queen = 16.5 mg, range 15.5–17.0 mg, $n = 10$. For workers, mean = 11.5 mg, range 8.0–14.5 mg, $n = 100$.)

Nest Entrance.—Nest entrances extend 1–4 cm out from the slope to form a characteristic funnel (Fig. 1). The funnel is oval, typically about 3 cm in diameter (though occasionally larger) but often narrower where it joins the slope. A narrow nest entrance, open throughout the year in most nests, is present in the middle of the funnel.

Nest Chambers.—All 26 nests excavated had two nest chambers, although colonies collected varied considerably in size (8 to 72 workers). Larger colonies also had only two nest chambers but enlarged. (The nests were mature since they seasonally contained multiple alates of both sexes). However, one large colony (59 workers) had a third rather irregular nest chamber.

The two nest chambers are typically disk-shaped and slightly domed in the center (Fig. 1). The wall to the nest chamber is very smooth and evenly sculptured in the clay. Workers often congregate in occasional small extensions to the chambers (“alcoves,” Fig. 1b). The upper and lower chambers are separated by a thin partition and connected by a single funnel.

Funnel Connection.—A remarkable funnel provides the only connection between the upper and lower nest chambers (Fig. 2). The funnel is typically about 2 cm in diameter with a narrow 5–8 mm hole for the ants to pass through. The funnel is above the highest part of the domed lower chamber and connects to the

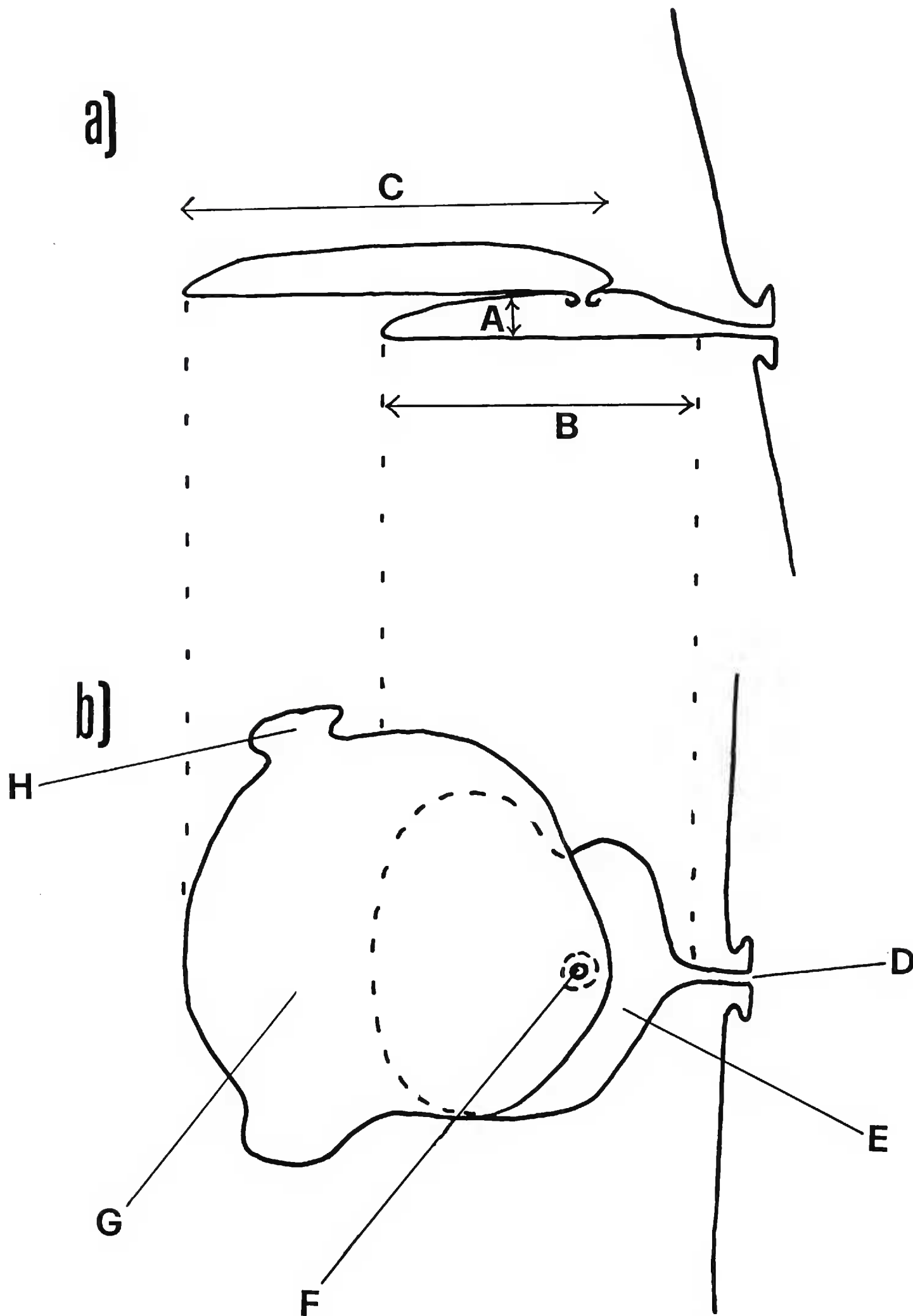


Figure 1. Typical nest structure of *Harpegnathos venator*. (a) Vertical lateral cross-section of nest. (b) View from above. Typical measurements are: A = 1.5–2 cm; B = 5–12 cm and; C = 6–16 cm. D = Nest entrance, E = Lower chamber, F = Funnel connection between lower and upper chamber, G = Upper chamber, H = “Alcove.”

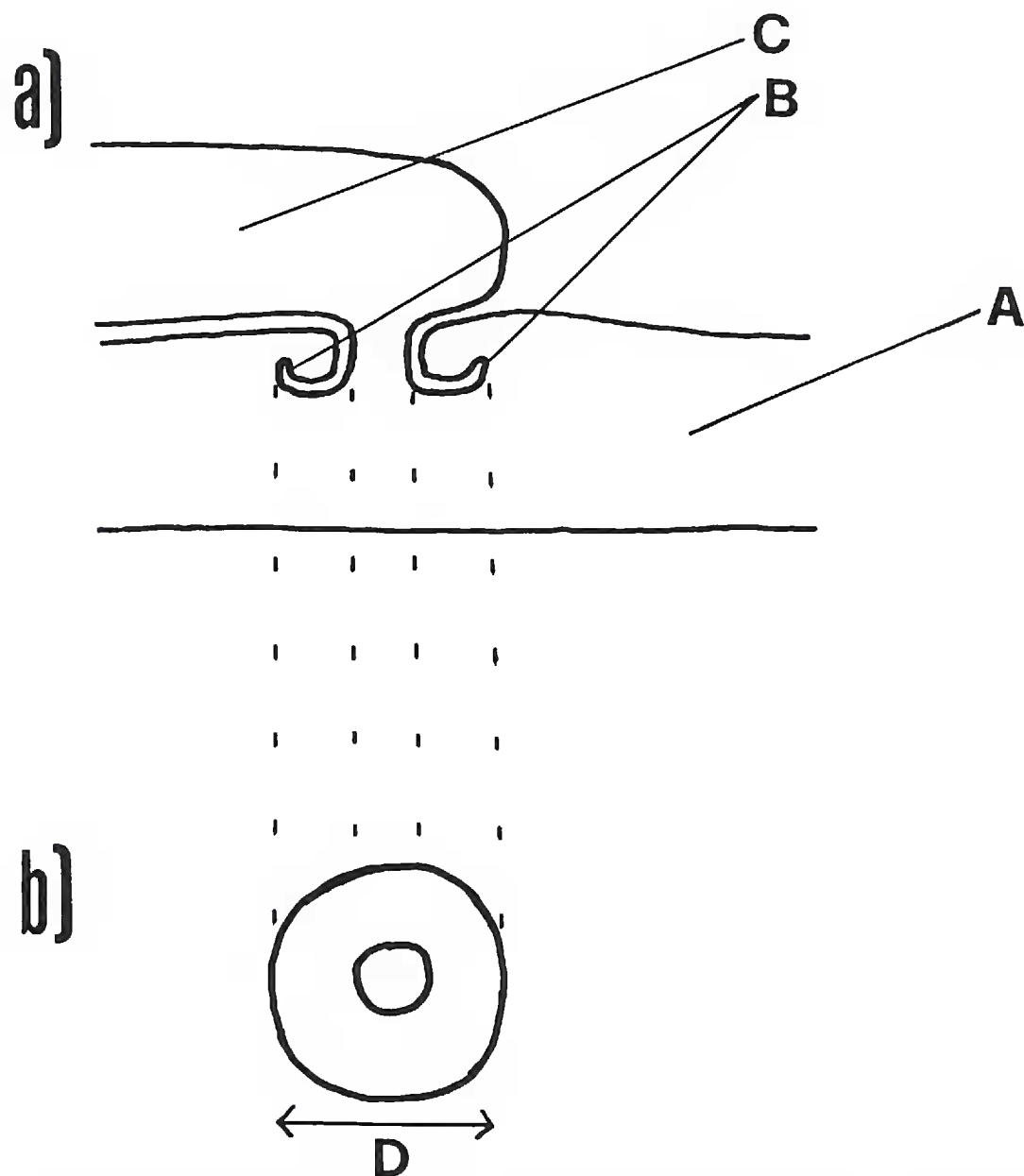


Figure 2. Funnel between upper and lower nest chambers. (a) Vertical lateral cross-section. (b) View of circular funnel from below. A = Lower nest chamber; B = Upturned lip of funnel; C = Upper chamber; D = Diameter of funnel = about 2 cm.

front of the upper chamber. The circular funnel is sculptured from clay and has an upturned lip (Fig. 2).

DISCUSSION

The present paper describes the two-chambered nest of *H. venator* which is amongst the simplest recorded in mature colonies of ants, though the nest also has a remarkable internal funnel connection. Primitive characteristics of *H. venator* included small colony size and little size differentiation between queens and workers.

Nests of mature ant colonies typically contain a complex of multiple nest chambers, (often dozens or even hundreds, Sudd 1967, Dumpert 1981, Hölldobler & Wilson 1990). Even primitive *Myrmecia* ants in Australia have large complex nests with multiple nest chambers (Gray 1971). The uniformity in the design of the simple two-chambered nest among *H. venator* colonies was most striking. Only small variations occurred among nests, for example, as a result of large rocks in the clay interfering with the typical disk-shaped nest chambers.

The funnel connection between the two nest chambers is interesting, with no

similar structure being recorded in the major reviews on ant nest structure (Wheeler 1910, Sudd 1967, Dumpert 1981, Hölldobler & Wilson 1990). The funnel is typically about 2 cm above the floor of the lower chamber. R. Winney (personal communication) speculates that *H. venator* may need their jumping ability to get from the lower chamber into the funnel. Most ants were found in the upper chamber and clearly evacuation to the upper chamber would facilitate escape against arthropod predators entering the nest.

Primitive characteristics found in *H. venator* included nesting in soil, small colony size, slow tempo of worker movement and little size differentiation between queens and workers. Nests of ants are thought to have first evolved in soil and later developed a diversity of locations, e.g., nesting inside plants, tree-trunks or using leaves of trees to build nests (Dumpert 1981). The small colony size found in *H. venator* (a mean of only 35 workers) further points to their primitiveness (no large complex society having evolved). This colony size is amongst the lowest known in ants (Hölldobler & Wilson 1990), though at least three ant species are known with even smaller colonies (Peeters et al. 1991). However, most ant species including the primitive *Myrmecia* ants have evolved the ability to develop much larger colonies (typically several hundred workers in *Myrmecia*, Hölldobler & Wilson 1990).

True morphologically-distinct queens were found in nests of *H. venator*. This contrasts with some other primitive ponerine ants where the queen caste has been replaced by reproductive workers (Peeters 1991). Interestingly in the other major group of primitive ants, the subfamily Myrmeciinae, the queen caste is always found in all species so far examined (Haskins 1970; Crosland, unpublished data). Queens of *H. venator* are little larger than workers. Similar queens, little larger than workers, are also found in some primitive *Myrmecia* species (reviewed in Wilson 1971). Worker-like queens are sometimes referred to as "ergatoid." However, the recent suggestion is to reserve the term "ergatoid" for intermediates between normal queens and workers that can replace the ordinary queen caste (Hölldobler & Wilson 1990). Hence *H. venator* queens are not ergatoid. Queens of *Myrmecia* and *H. venator* contrast with those of higher ants such as *Camponotus* where queens are approximately 20 times the weight of minor workers (Crosland 1990).

Ant queens typically found colonies claustrally, in a closed underground chamber where the first larvae are fed on food reserves and digested alary muscles from the body of the lone queen. Worker-like *Myrmecia* queens are primitive amongst ants in that the single colony-founding queen periodically leaves her underground chamber to forage, presumably because her worker-like body has insufficient food reserves to rear her first brood (Wilson 1971). Experiments are planned to test whether similar queen foraging also occurs in *H. venator*.

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Note added in proofs: The nest architecture of *Harpegnathos saltator* will soon be published in: Peeters, C., B. Hölldobler, M. Moffett & T. M. Mustak Ali. 1994. "Wall-papering" and elaborate nest architecture in the ponerine ant *Harpegnathos saltator*. *Insectes Sociaux* (in press).

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